Integrating Environment, Safety, & Health (ESH) Considerations Into the Systems Engineering Process

OUTLINE

- **Purpose**
- **Background**
- **Rationale**
- **Requirements & Guidance**
- **Implementation**
- **Summary**

Purpose of this Session

- **Inform you of DOD ESH integration requirements**
- **Convey a few basic learning objectives**

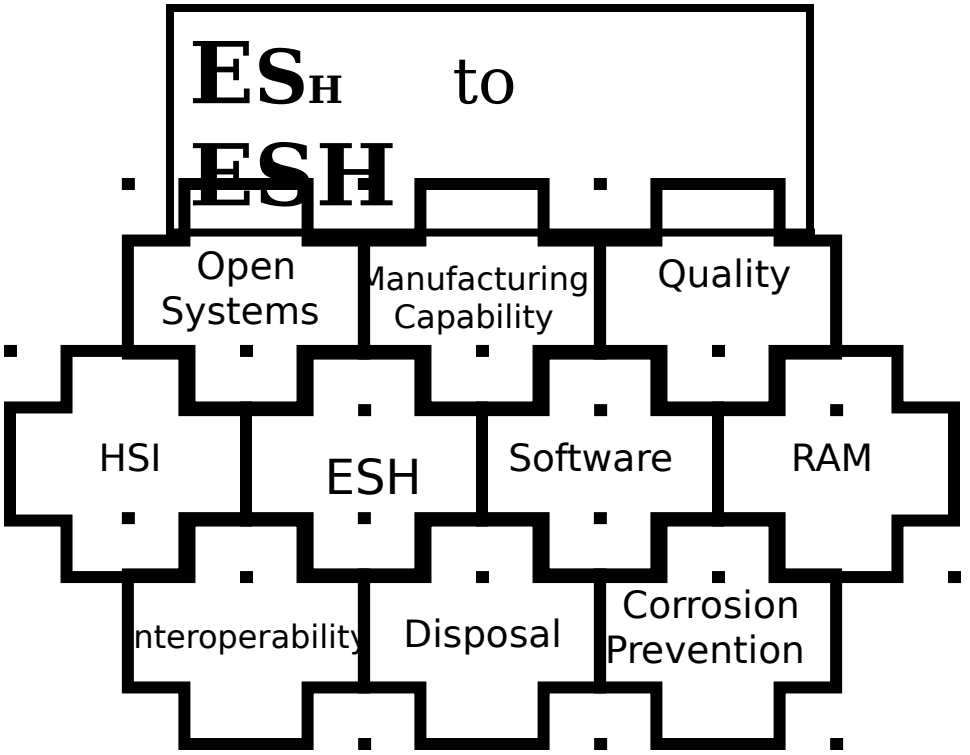
NOTE: This session is *not* intended to make you an E, S, or H expert!

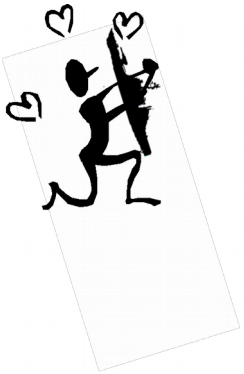
KEY LEARNING OBJECTIVES

#1 Balance the three ESH topic areas

#2 Integrate ESH considerations into the Systems Engineering process

#3 Recognize how effective ESH Risk management helps the User





DOD 5000 Series Policy (May 2002)

- **Shifts assignment of PM one phase later**
- **Replaces regulation with “guide”**
- **Moves ESH under HSI**
- **Four pages of ESH requirements to one-quarter page**
- **Staff elements expressed concern over new policies**

Federal Agency Lessons Learned

- **GAO estimates U.S. Clean-up equals S&L bail-out**
- **Legal liability protection to Industry may have been eroded**
- **Milestones lack sufficient information for informed decisions**
- **Safety hazards to test personnel not always been minimized**
- **Noise levels are adversely impacting system fielding**
- **ESH-related LCC/TOC impacts have not always been identified**
- **Misconceptions over “grand fathering” new requirements exist**
- **Beryllium usage has seriously harmed employee health**
- **Some “Faster, Better, Cheaper” approaches resulted in problems**
- **Inadequate NEPA planning has impacted program testing**

Rationale for Integrating ESH

- **It is required**
- **It reduces risks**
- **It reduces Total Ownership Cost (TOC)**
- **It improves operational readiness**
- **It makes good business sense**

Approved Requirements (12 May 2003)

3.7 System Development & Demonstration

3.7.1 Purpose

3.7.1.1 The purpose of the SDD phase is to develop a system or an increment of capability; reduce integration and manufacturing risk (technology risk reduction occurs during Technology Development); ensure operational supportability with particular attention to reducing the logistics footprint; **implement human systems integration (HSI)…**

3.7.4 Proceeding beyond the Design Readiness Review. The Design Readiness Review during SDD provides an opportunity for mid-phase assessment of design maturity as evidenced by measures such as… **an assessment of environment, safety and occupational health risks**; a completed failure modes and effects analysis; the identification of key system characteristics and critical manufacturing processes; an estimate of system reliability based on demonstrated reliability rates; etc.

Approved Requirements (12 May 2003)

3.9 Operations and Support

3.9.2 Sustainment

3.9.2.1 Sustainment **includes…environmental, safety (including explosives safety), occupational health…**

3.9.2.2 Effective sustainment of weapon systems begins with the design and development of reliable and maintainable systems through the continuous application of a robust systems engineering methodology. As a part of this process, the PM shall employ human factors engineering to design systems that…are suitable (habitable and **safe with minimal environmental and occupational health hazards**) and survivable (for both the crew and equipment)…

3.9.3 Disposal. At the end of its useful life, a system shall be demilitarized and disposed in accordance with all legal and regulatory requirements and policy relating to safety (including explosives safety), security, and the environment. During the design process, PMs shall **document hazardous materials contained in the system, and shall estimate and plan for the system's demilitarization and safe disposal.**

Approved Requirements (12 May 2003)

Table E3.T1. Statutory Information Requirements

Information Required	Applicable Statute	When Required
Programmatic Environmental Safety and Occupational Health Evaluation (PESHE) (Including National Environmental Policy Act Schedule)	42 U.S.C. 4321, reference (x)	Program Initiation for Ships MS B MS C Full-Rate Production DR

Approved Requirements (12 May 2003)

ENCLOSURE 5 INTEGRATED TEST AND EVALUATION (T&E)

E5.1 …The T&E strategy shall provide information about risk and risk mitigation…The PM, in concert with the user and test communities, shall provide **safety releases** to the developmental and operational testers prior to any test using personnel.

E5.4 T&E Planning

E5.4.5 **Planning shall consider the potential testing impacts on the environment (42 U.S.C. 4321-4370d and E.O. 12114, references (x) and (az)).**

Approved Requirements (12 May 2003)

ENCLOSURE 7 HUMAN SYSTEMS INTEGRATION (HSI)

E7.1 General. The PM shall have a comprehensive plan for HSI in place early in the acquisition process…HSI planning shall be summarized in the acquisition strategy and address the following:

E7.7 Environment, Safety and Occupational Health (ESOH). As part of risk reduction, the PM shall prevent ESOH hazards where possible, and shall manage ESOH hazards where they cannot be avoided. The acquisition strategy shall incorporate a summary of the Programmatic ESOH Evaluation (PESHE), including ESOH risks, a strategy for integrating ESOH considerations into the systems engineering process, identification of ESOH responsibilities, a method for tracking progress, and a compliance schedule for NEPA (42 U.S.C. 4321-4370d and Executive Order 12114, references (x) and (az)). During system design, the PM shall document hazardous materials used in the system and plan for the system's demilitarization and disposal. The CAE (or for joint programs, the CAE of the Lead Executive Component) or designee, is the approval authority for system-related NEPA and E.O. 12114 documentation. For acceptance of ESOH mishap risks identified by the program, the CAE is the acceptance authority for high risks, PEO-level for serious risks, and the PM for medium and low risks as defined in the industry standard for system safety.

Outstanding Issues with the Requirements

- **New policies use "ESOH" vice "ESH" and are inconsistent with NEPA's requirement to address health issues beyond OH**

- **ESH considerations before MS B not addressed; therefore no ESH-related technology risk reduction between MS A & B**

- **ESH now a subset of HSI requirements; but "E" not traditionally included in HSI**

- **PESHE listed in "Statutory Info Requirements" under NEPA; but NEPA (the law) makes no mention of the PESHE**

- **No clarification of PESHE process; therefore confusion over PESHE, PEHSE document, and PESHE summary**

- **ESH risk acceptance from the "industry standard" is required; but the policy and the standard are inconsistent in this area**

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Guidebook Selected Sections Containing ESH Info

4.2.3.5 Risk Management

- **Risk management approaches includes ESH considerations**

4.3.3.3.1 Interpret User Needs, Refine System Performance Specs & Environmental Constraints

- **Gives example that PM should plan for the ESH assessment**

4.3.3.3.4 Evolve CI Functional Specs into Product (Build-to) Documentation & Inspection Plan

- **ESH should be part of decision-making & trade studies**

Guidebook Selected Sections Containing ESH Info

4.3.3.4.5 Critical Design Reviews

- Has the detailed design satisfied HSI requirements?
- Are Critical Safety Items identified?

4.3.3.5 Outputs of SE Process/Inputs to the Design Readiness Review

- An assessment of ESH risks
- Completed failure modes and effects analysis

4.3.5.5 Outputs of SE Process in Operations & Support

- PESHE
- NEPA Compliance Schedule

4.4 SE Decisions: Important Design Considerations

- Includes ESH an important design consideration

Guidebook Selected Sections Containing ESH Info

4.4.11 ESH

PM required to have PESHE document that describes

- **Strategy for integrating ESH considerations**
  - **MIL-STD-882D or an equivalent**
- **The NEPA schedule**
- **The status of ESOH risks management**
  - **Identification, assessment, mitigation, residual risk acceptance, and on-going evaluations**

Acquisition Strategy includes a summary of the PESHE

Guidebook says from MS B on, PESHE serves as a "repository" ***be careful with this statement!!!!!***

Guidebook Selected Sections Containing ESH Info

4.4.11 ESH (continued)

The ESOH systems engineering activities:

- **Programmatic Environment, Safety, and Occupational Health Evaluation (PESHE);**
- **ESOH Risk Management; and**
- **Review and update Designated Science and Technology Information, the Security Classification Guide, and the Counterintelligence Support Plan.**

Guidebook also points to ESOH Special Interest Area on the Acquisition Community Connection web site.

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4.4.11.1 PESHE

The PESHE includes the following:

- **Strategy for integrating ESH considerations into the systems engineering process**
- **Identification of who is responsible for implementing the ESH strategy**
- **Approach to identifying ESH risks**
- **Identification, assessment, mitigation, and acceptance of ESH risks.**

Guidebook Selected Sections Containing ESH Info

4.4.11.1 PESHE (continued)

- **Method for tracking progress**
  - **management and mitigation of ESH risks**
  - **measuring effectiveness of ESH risk controls**
- **Compliance schedule for completing National Environmental Policy Act (NEPA)/ Executive Order 12114 documentation;**
- **Identification of HAZMAT, including energetics**
- **Approach for & progress integrating HAZMAT, energetics, and other ESH considerations into system demilitarization and disposal planning**
- **Approach for, and progress in, integrating ESH into test and evaluation (T&E) planning and reporting.**

Guidebook Selected Sections Containing ESH Info

4.4.11.2 ESH Risk Management

- **Balancing ESH risk with an informed and structured residual risk acceptance process**
- **ESH risks are part of each program's overall cost, schedule, and performance risks,**
- **Risk acceptance is necessary to**
  - **avoid loss of life or serious injury to personnel**
  - **serious damage to facilities or equipment resulting in large dollar loss**
  - **failures with adverse impact on mission capability, mission operability, or public opinion**
  - **harm to the environment and the surrounding community.**

Guidebook Selected Sections Containing ESH Info

4.4.11.2 ESH Risk Management (continued)

The ESH risk management process uses ESH risk analysis matrices

- **based on the guidance in MIL-STD-882D.**
- **risk matrices should use clearly defined probability and severity criteria (either qualitative or quantitative) to categorize ESH risks.**
- **PMs elect to either establish a single consolidated ESH risk matrix or use individual environmental, safety, and occupational health matrices.**

Guidebook Selected Sections Containing ESH Info

9.1.7 ESH (Note: this is part of intro to T&E)

- **The T&E Strategy and TEMP should address PM's:**
  - **analysis of residual ESH risks and control measures**
  - **NEPA/E.O.12114 documentation requirements & how analyses will support test site selection decisions**

- **Early participation of ESH expertise on the T&E WIPT**
  - **assures appropriate issues are addressed during test planning and execution.**

- **PM must ensure compliance with NEPA/E.O. 12114**
  - **particularly as they affect test ranges and operational areas.**

Guidebook Selected Sections Containing ESH Info

9.1.7 ESH (Note: this is part of intro to T&E) (continued)

- **After appropriate hazard analysis, the PM is required to provide safety releases to developmental and operational testers prior to any test using personnel.**

- **Safe test planning includes analysis of the safety release related to**
  - **test procedures**
  - **Equipment**
  - **training.**

- **A full safety release is expected before IOT&E.**

Implementing ESH Integration
"The Who, What, When & How"

IMPLEMENTING ESH INTEGRATION (It is no different than any other design issue!)

- **WHO?: Start with the right players**
- **WHAT?: Follow an ESH functional analysis (i.e., the PESHE)**
- **WHEN?: Implement early in the systems engineering process**
- **HOW?: Utilize people together with thought process**
  - **Integrate into trade studies**
  - **Follow the three-step risk management approach:**
    - **Identify risks**
    - **Analyze risks**
    - **Mitigate risks**
  - **Document results**
  - **Influence procurement process**

WHO? - START WITH THE RIGHT PLAYERS (Use the IPPD/IPT Approach)

- **Program personnel**
- **Users & installations**
- **Functionals**
  - **Designers (all aspects)**
  - **Manufacturing**
  - **T&E managers**
  - **ILS specialists**
  - **Cost estimators**
  - **Environmental managers**
  - **Applicable sub-disciplines of safety engineering**
  - **Medical specialists (e.g., Occ. Health, Indus. Hygiene)**
  - **Legal & Public Affairs**
  - **Others (contracts, DMCA, SUPSHIPs, Command Staff, etc.)**

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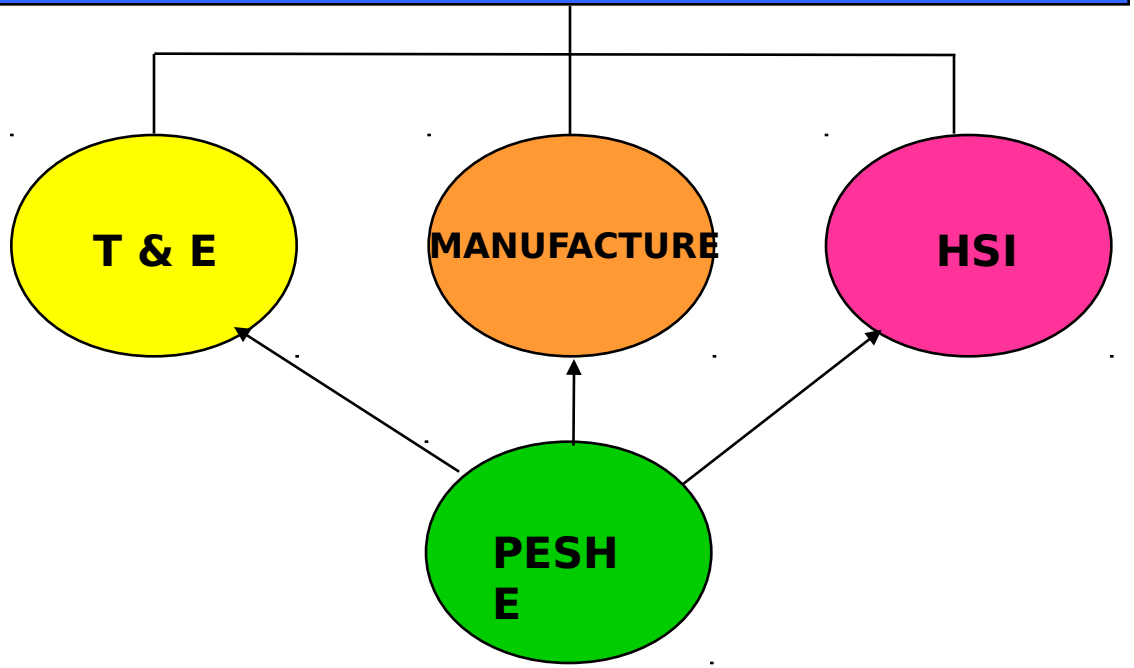
WHAT? – PESHE IS A FUNCTIONAL ANALYSIS (It is a part of the Systems Engineering process)

ACQUISITION STRATEGY



FUNCTIONAL ANALYSES

RISK MANAGEMENT ISSUES

Programmatic: TOC, Schedule, Performance

Technical: ESH & other technical considerations

ESH: Compliance, NEPA, Safety/ Health, HazMats, P2, Explosives

WHAT ARE ESH ISSUES ?

- **Environment**

  What program does to environment

  What environmental requirements do to program

- **Safety**

  Examples include: system safety, software safety, explosives safety, laser safety, occupational safety, public safety, etc.

- **Health**

  Occupational health

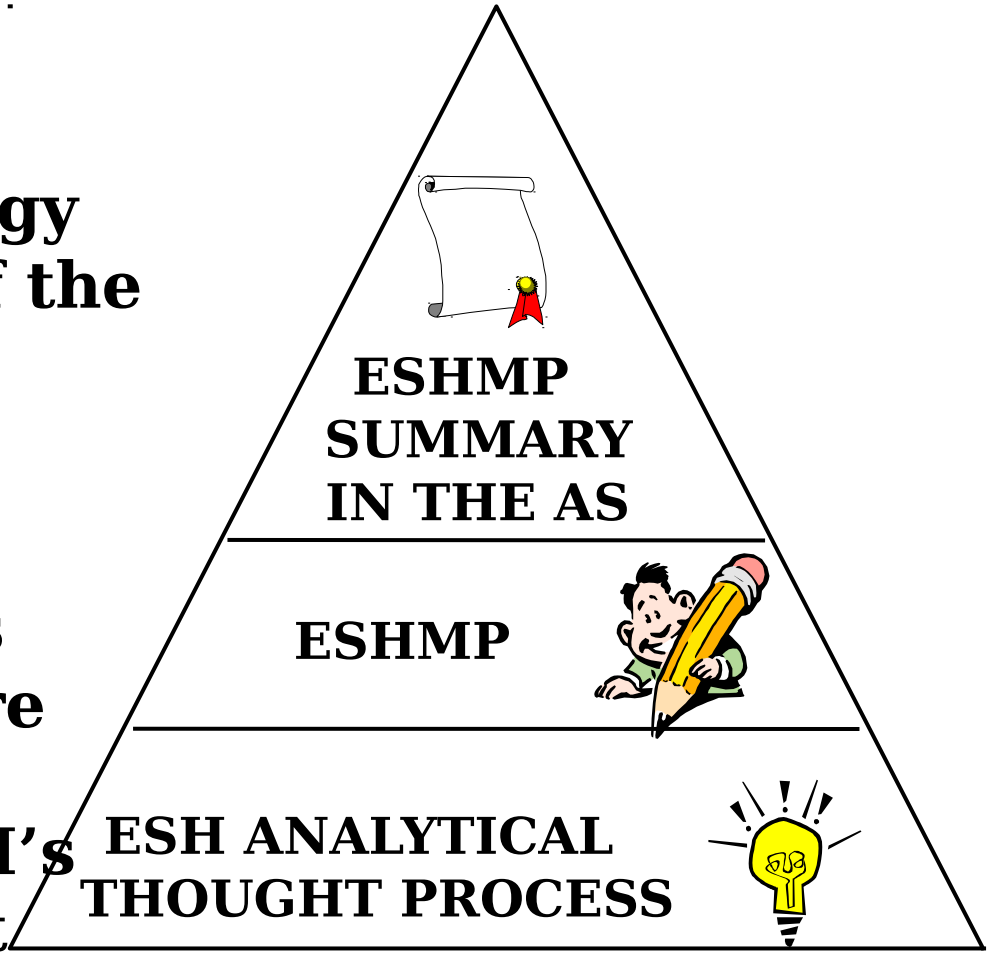
  Community health

The PESHE Process

The Acquisition Strategy contains a summary of the ESH Master Plan

Think of "PESHE document" as the PM's ESH Master Plan, where the thought process is documented

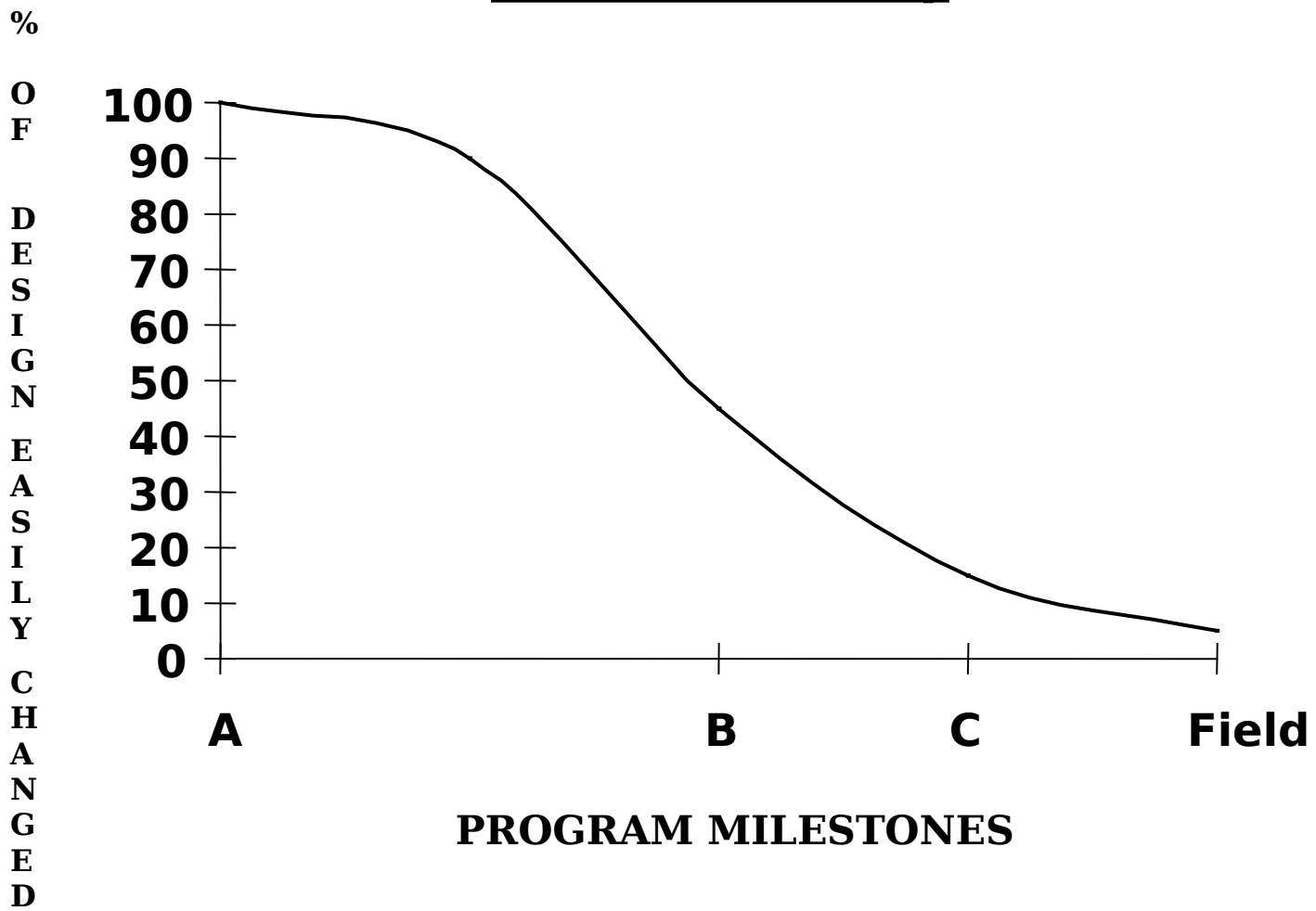
The "PESHE" is the PM's ESH analytical thought process



WHEN? - EARLY IN THE SYSTEMS ENGINEERING PROCESS

- **As early in the design effort as possible**
- **Not later than when first prototypes are developed**
- **When trade studies are conducted:**
  - **Materials**
  - **Industrial processes**
- **When developing:**
  - **New systems**
  - **Alterations & Modifications to existing systems**
  - **Major Repairs**

ESH INTEGRATION - DO IT EARLY (It is easier to change paper than hardware!)



HOW?- INTEGRATE INTO TRADE STUDIES

- **Include all aspects of system engineering (i.e., design through disposal)**
- **Be sure to include trade study decisions below the prime**
- **Be sure trade study decisions are based on TOC**
- **Use proven support techniques**
  - **Risk management approach**
  - **Team building**
  - **Work breakdown structure**
- **Most trade studies are performed by the contractor, so be sure to influence the procurement process**

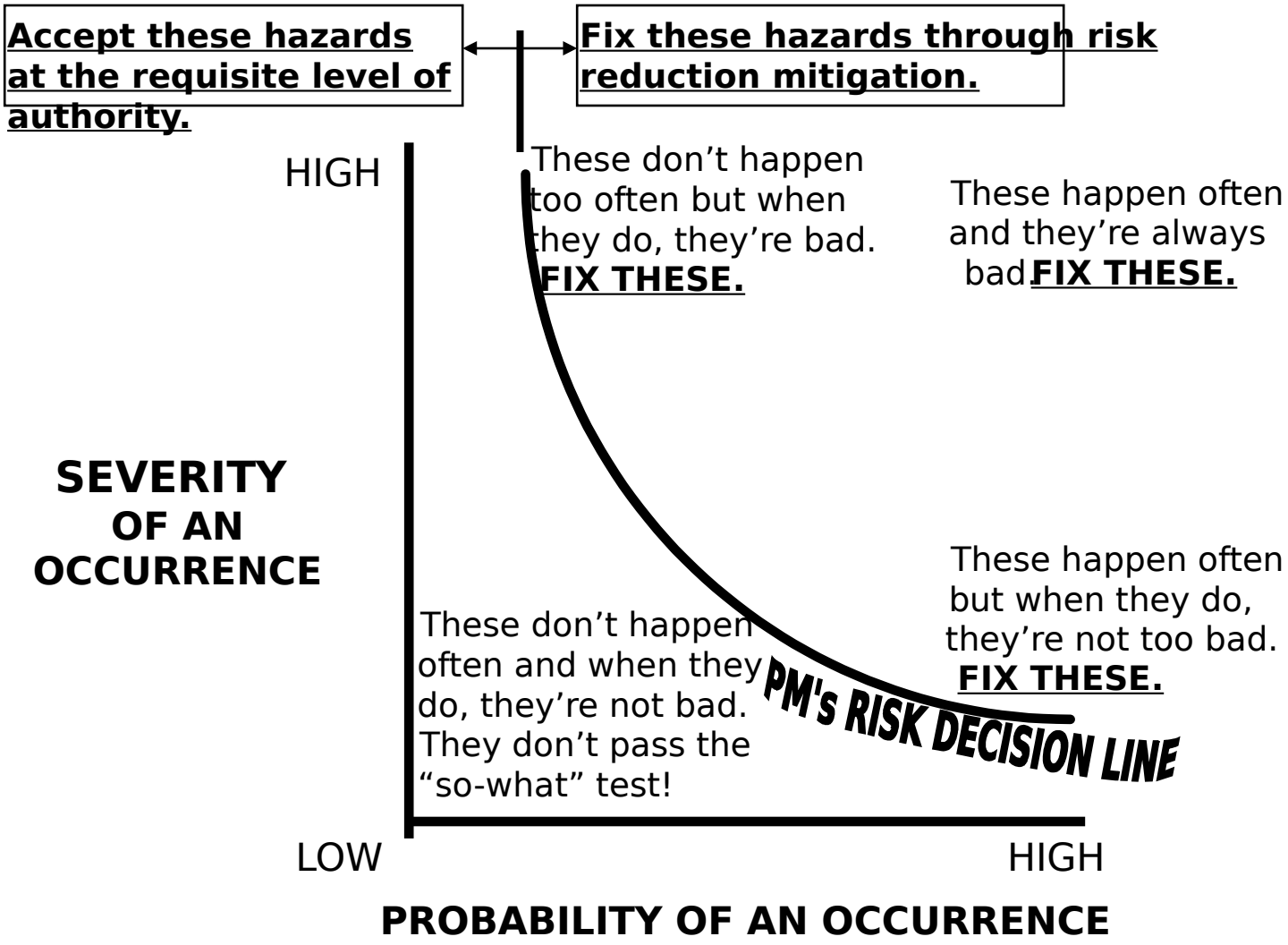
RISK MANAGEMENT APPROACH STEP #1 - IDENTIFY RISKS

- **Begin with "list-based" approach**
  - **ODS**
    - **Class I production ban since 1994**
    - **Class II (90%) production ban by 2015**
  - **EPA-33**
  - **Releases (use TRI Report)**
  - **Multi-media issues**
    - **Noise**
    - **Pollution**
  - **Others as appropriate**
    - **Composites in structures & components**
    - **Lithium in power sources**
    - **Depleted Uranium in munitions & armor**
    - **Aqueous Film Forming Foam (AFFF)**

RISK MANAGEMENT APPROACH STEP #2 - ANALYZE RISKS

- **Narrow the focus with "risk-based" analysis**
  - **Total Ownership Cost drivers**
  - **Potential "show-stoppers"**
  - **Must address all of the system's life cycle**
- **Use MIL-STD-882 approach**
  - **Proven methodology**
  - **Accepted by government & industry**
  - **Probability of occurrence versus severity**
- **Ensure levels of hazards are approved**
  - **High approved by CAE**
  - **Serious approved by PEO**
  - **Medium & Low approved by PM**

EVALUATING ESH HAZARDS BASED ON SEVERITY VS PROBABILITY OF OCCURRENCE


Accept these hazards at the requisite level of authority.
Fix these hazards through risk reduction mitigation.
HIGH
These don't happen too often but when they do, they're bad. FIX THESE.
These happen often and they're always bad. FIX THESE.
SEVERITY OF AN OCCURRENCE
These don't happen often and when they do, they're not bad. They don't pass the "so-what" test!
These happen often but when they do, they're not too bad. FIX THESE.
PM's RISK DECISION LINE
LOW
HIGH
PROBABILITY OF AN OCCURRENCE

RISK MANAGEMENT APPROACH STEP #3 – MITIGATION

"CHANGING PAPER IS EASIER THAN CHANGING HARDWARE"

- **Address mitigation in Concept & Technology Development phase**
- **Implement mitigation in System Development & Demonstration phase**
  - **Or whenever first prototype is built**
  - **This is the most often missed opportunity**
  - **Provides optimum risk reduction measure**
- **Be sure Users are involved**
  - **Help to prioritize mitigation measures**
  - **Help to build & defend projects**

MOST SOLUTIONS ARE OUT THERE - BE SURE TO LOOK FOR THEM

DOCUMENT RESULTS

- **Remember to analyze & document**
  - **ESH master plan**
  - **NEPA decisions *before* *taking* an action**
  - **Risk acceptance**
- **Actions may include:**
  - **Test**
  - **Fielding**
  - **Operation & maintenance (e.g., dredging)**
  - **Demilitarization & disposal**
- **Be sure:**
  - **Procurement documents reflect ESH**
  - **Program file (administrative record) includes ESH info**
    - **ESH master plan with ESH analyses**
    - **NEPA & risk acceptance documents/approvals**
    - **Key ESH decision documents**
    - **Annual ESH checklist**

INFLUENCE THE PROCUREMENT PROCESS

- **CI/NDI Market Survey/Investigation**
- **Statement Of Work (SOW)/ Statement Of Objective (SOO)**
- **Request For Proposals (RFP)**

I/NDI MARKET SURVEY/INVESTIGATION

- **Potential supplier's data should include:**
  - **Environmental "track record" (e.g., TRI data)**
  - **Use of**
    - **CLASS I & II ODSs**
    - **EPA-33**
    - **TRI**
    - **OTHERS**
- **Have offerors ?**
  - **Instituted HAZMAT elimination efforts in:**
    - **Design**
    - **Manufacturing**
    - **Maintenance**
  - **Instituted key management concepts**
    - **Environmental management system (e.g., Tenets of ISO 14001)**
    - **HMMP (e.g., tenets of NAS 411)**
    - **System safety & health program (e.g., tenets of MIL-STD-882)**

STATEMENT OF WORK (SOW) STATEMENT OF OBJECTIVES (SOO)

- **Hazardous Materials Management Program (HMMP)**
  - **Consideration over life cycle**
- **Consider prohibition of:**
  - **Class I ODSs (for all cases)**
  - **Class II ODSs (if service life goes beyond 2015)**
- **Limit to minimal use of:**
  - **EPA-33**
  - **Global warming substances**
  - **Others (Lithium, AFFF, DU, etc.)**
- **Include MIL-STD-882 requirements**
  - **Be sure to tailor specific task requirements**

REQUEST FOR PROPOSAL (RFP)

- **Ask offerors to explain their approach to integrating ESH issues into their systems engineering process, to include:**
  - **Design**
  - **Test**
  - **Manufacturing**
  - **Operation & maintenance**
  - **Disposal**
  - **TOC impacts**
- **Include:**
  - **HMMP**
  - **Safety & health task deliverables**
- **Address offerors' TRI data**
- **Use Sections L & M to send our “message”**

SEND THE CORRECT MESSAGE

- **Section L, instruct the offerors to tell us:**
  - **How they will manage ESH hazards**
    - **Organization, expertise, integration**
    - **Their prioritization scheme**
    - **Identification, track & notify government**
  - **How they will manage HAZMATs (I.E., HMMP Plan)**
  - **How they will address life cycle**
    - **Costs**
    - **O&S issues**
    - **Disposal issues**

- **Section M, tell them what we will use to evaluate**
  - **MIL-STD-882 tenets - overall hazard management**
  - **NAS-411 tenets - HMMP Plan**

WHAT TO LOOK FOR IN THE EVALUATION

- **Does offeror understand how to manage ESH risks?**
  - **Already using MIL-STD-882 tenets**
  - **People - Integrates ESH experts into the design**
  - **Organization - Avoids stovepipes**
  - **Methodology - Identify, assess, mitigate, notify**
- **Does offeror understand what makes a good HMMP**
  - **Right mix of people, at right level of management**
  - **Integrated into systems engineering process**
    - **Design - manufacture - operation - support - disposal**
  - **Decisions based on:**
    - **Sound prioritization process (severity versus occurrence)**
    - **Life cycle considerations**
    - **Balanced ESH input**
    - **Total Ownership Costs (TOC)**

SUMMARY

- **Integration of ESH issues into the systems engineering process applies to all PMs.**
- **Policy & new guidance may cause some confusion.**
- **PMs do not have blanket authority in accepting all ESH hazards**
- **ESH Integration is no different than any other functional consideration.**
- **ESH integration needs to be incorporated early.**
- **ESH Risk Management approach has been identified.**
- **Users need to part of the process.**
- **ESH workshops & guides have helped PMs & their staffs.**

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REMEMBER

The goal is to make the integration of ESH into the systems engineering process,

a thought process

rather than just an

afterthought!